
ComAp
Improving energy efficiency with smart control
Case studies & Lessons Learnt
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Outline

- About ComAp
- Complex hybrid systems
- Diesel gen-set – a must?
- Case studies
- PV penetration levels
- Site control algorithms
- Lessons learnt
- Conclusion

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About us

ComAp in Numbers

We specialize on development of smart electronic control systems and solutions for the power generation industry.

400
Great People

28 Years
of Experience

120 000
Controllers Shipped in 2018

52M€
2018 Turnover

1
Global Distributor Network

11
Subsidiaries

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Local Presence

Our focus on local presence
and being close to our customers
is a clear differentiator in our industry

18
ComAp Offices

50+
Distributors

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Focused Markets

- Datacentres
- Power Plants
- Industrial
- Mining
- Commercial Buildings
- Agriculture
- Rental
- Renewables
- Hospitals
- Telecom
- Oil and Gas
- Events
- Marine
- Construction
- Military

Hybrid system definition

Diesel generator system

Photovoltaic or wind turbine system

Hybrid power system

- Combination of reciprocating gen-sets and renewable sources of power
- On-grid as well as off-grid applications

Hybrid projects - end user landscape

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Diesel Genset Power

aggreko

JUBAILI BROS
جبيلي اخوان

ZEPPELIN CAT

ComAp

TEKSAN

TTS
MARTIN, s.r.o.

KOHLER SDMO

iLTEKNO

STERLING & WILSON

solaredge

ABB

QINOUS

SUNGROW

Schneider Electric

DELTA

Fronius

SIEMENS

HUAWEI

SMA

SUNSPEC ALLIANCE

powering tomorrow
Growatt

KACO new energy.

invt

Renewable Energy Resources

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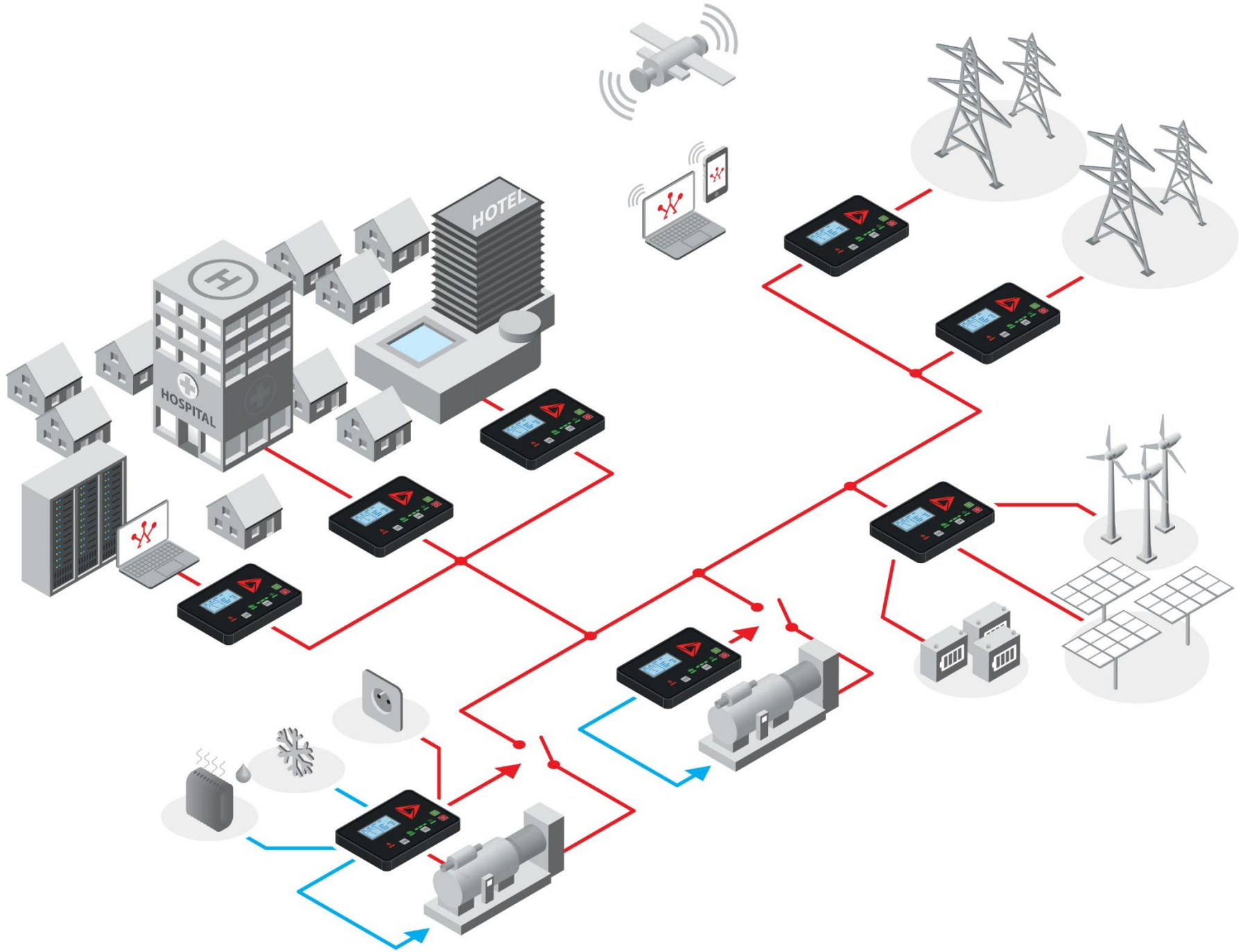

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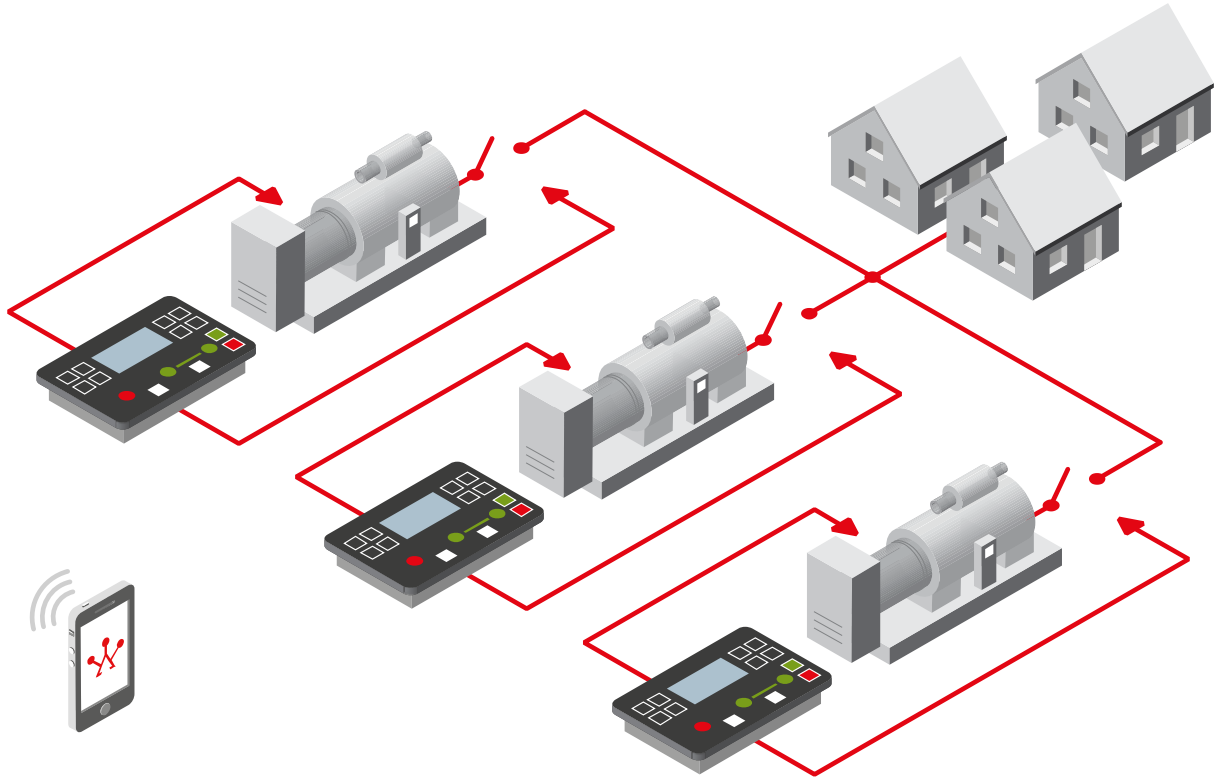

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Diesel gen-sets – a must?

- Emissions
- Noise
- Regular maintenance
- Diesel delivery and storage
- High OPEX

- No intermittency
- High reliability
- Flexibility to load fluctuations
- Robustness (maintains stable frequency)
- Significanty lower CAPEX than renewable resources

- The only power source for large populations not only in developing countries!
  - 600 GW of baseload diesel gen-sets globally
  - A necessary component of hybrid microgrid

Solar-Diesel Hybrid Power Plant Kiribati

Tarawa Island

- **Three 1400 kW low speed diesel generator systems**
- **500 kWp photovoltaic power plant**
- **The hybrid system saves approximately 227,000 litres of diesel every year**
- **Prevention from around 627 tons of CO_2 emissions**

Low PV penetration

- **Up to 30% penetration**

- Low specific requirements on the control system
- High reliability
- High utilization of the PV plant (low need to reduce the PV output)
- Low CAPEX
- Limited reduction of OPEX (remaining high OPEX)
- Low reduction of emissions

Suitable for sites with highly variable loads

Solar-Diesel Hybrid Power Plant Rarotonga

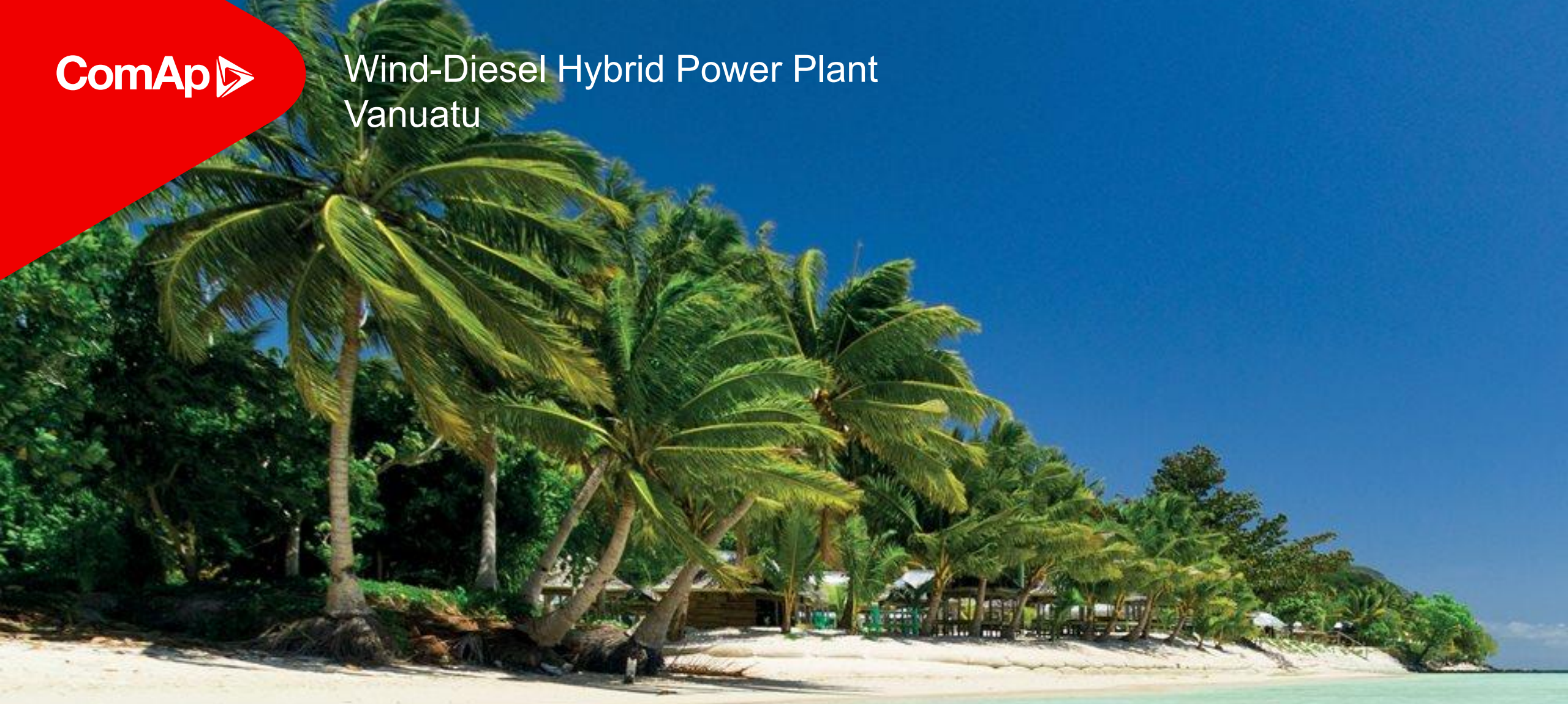
- Slow speed and high speed diesel gen-sets (total installed capacity 8.5 MW
- PV power plant (installed capacity of 0.65 MW)
- Adjustment of the power management and load sharing between the low speed and high speed diesel gen-sets was necessary to optimize the power supply and diesel consumption
- Automation of originally manual operation minimized the spinning reserve, reduced the fuel consumption and lowered the operation costs

Gen-sets of different rated power

- **Manual control cannot be used in complex hybrid systems**
- **Control system automation is paramount for sites with various gen-sets´ capacities due to**
  - Significantly faster response times
  - Ability to optimize gen-sets selection according to their rated power
  - Ability to achieve high efficiency of the site operation
  - Maximization of renewable energy utilization
  - Reduction of Dynamic Spinning Reserve

High speed sets should be used for DSR provision and slow speed sets should be used for baseload

Wind-Diesel Hybrid Power Plant Vanuatu



- Two diesel power plants (Four 800kW gen-sets and two 4 MW slow-speed diesel gen-sets)
- 3 MW wind farm
- The installed control system has allowed the wind energy penetration to be as high as 70% without any energy storage system

Medium PV penetration

Penetration from 30% to 60%

- High renewable energy output utilization, however curtailment is required
- Reduced gen-set operation, but underloading must be prevented
- Suitable for Demand side management
- Short term storage would minimize gen-sets operation, but would increase the upfront investment and prolong payback period
- Full control of PV and/or wind output necessary

- **Higher requirements on the control system design**
- **Optimized control algorithm is paramount not to compromise reliability and to utilize fully the renewable energy**

PV-Diesel-Storage Hybrid Power Plant
Willinga Park, Australia

- World Class Equestrian Centre – on-grid system with high peak load during events and gri import constraints
- Existing mains incomer and diesel gen-sets on site – PV power plant and Battery Energy Storage System was added
- PV plus Battery System only during non-event days (Gen-sets utilized for battery charging during sustained poor weather events)

Key Achievements of Willinga Park Hybrid System

- Reduced expenses on power supply
- Higher independence - No power cuts during network upgrades
- Revenue from export power
- Local DNSP support
- Lower operational risk
- Improved environmental footprint

High PV penetration

Up to 100% penetration

- The most demanding on the site control system
- Automatic gen-set control system is a must
- Optimized control algorithm designed according to site specifics is necessary
- Prevention to gen-sets underloading might reduce the utilization of renewable energy
- Reduction of renewable resource output is required more often – optimized interface to inverters is needed
- Energy storage is required to achieve 100% penetration without high DSR kept on gen-sets

Suitable for sites with stable day load and favourable PV conditions

Rottnest Island, Western Australia

- Diesel gen-sets integration with wind turbines, photovoltaic panels and water storage
- System enables black start hence higher renewable energy penetration is enhanced
- Optimization of the diesel gensets operation led to diesel fuel consumption reduction by 45%

Peter Island, British Virgin Islands

- Four diesel gen-sets (540kW each) and two wind turbines (259kW each)
- ComA optimized the power management for lower load reserve and efficient automatic control of the gen-sets operation to offset wind farm output fluctuations
- Fuel consumption costs cut by $500,000 per year

Wind-diesel power plant
Burgos Island, Philippines

Burgos Wind Farm

- **The largest wind farm in South East Asia; production of 233 GWh/year to provide power for a million households**
- **ComAp installed control system on back-up gensets**
  - Load picked up within 20s; zero spinning reserve required
  - Prevention of damage in high speed wind
  - Maximized fuel savings and efficiency while keeping high safety standard

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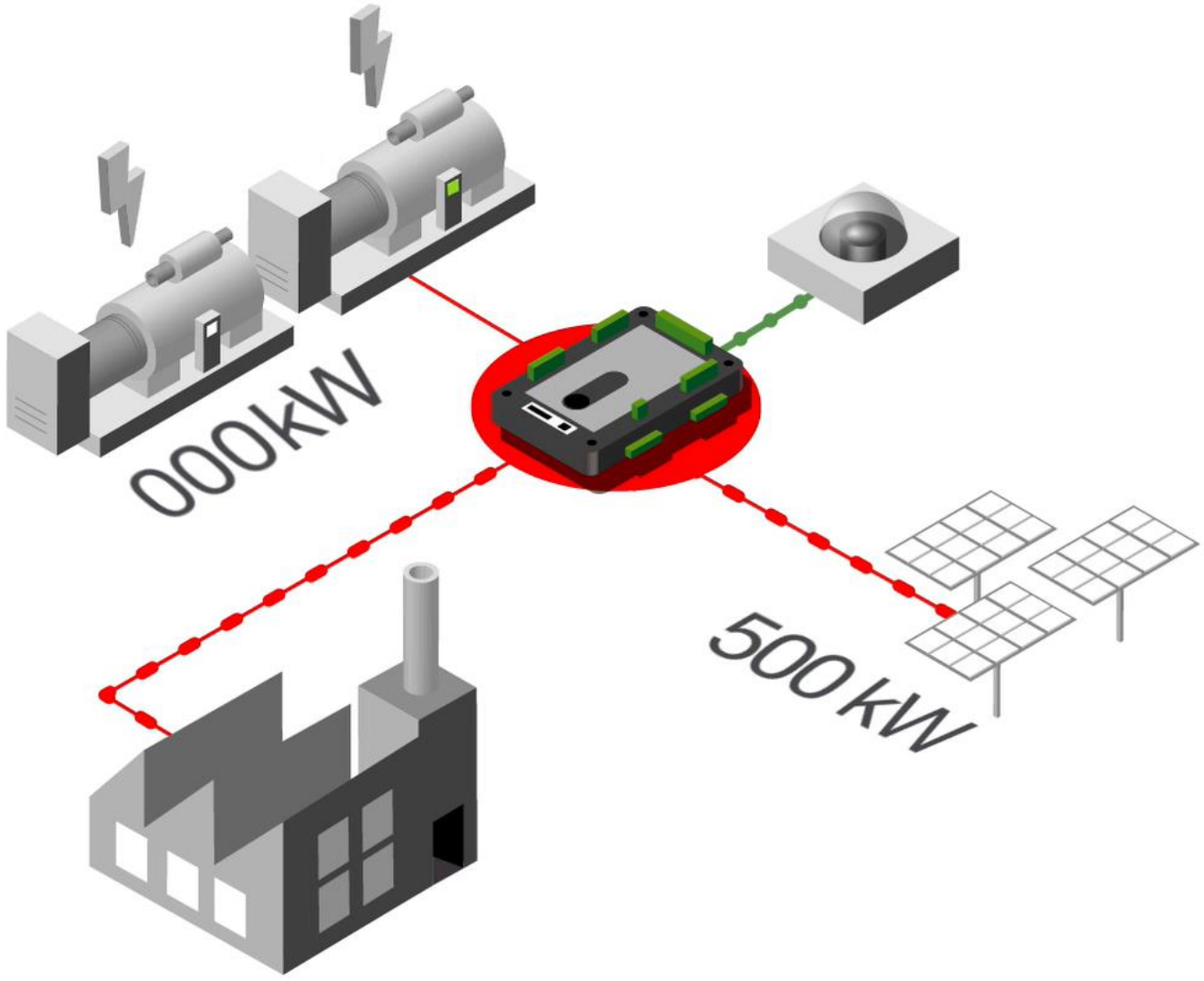
Cloud Forecasting System



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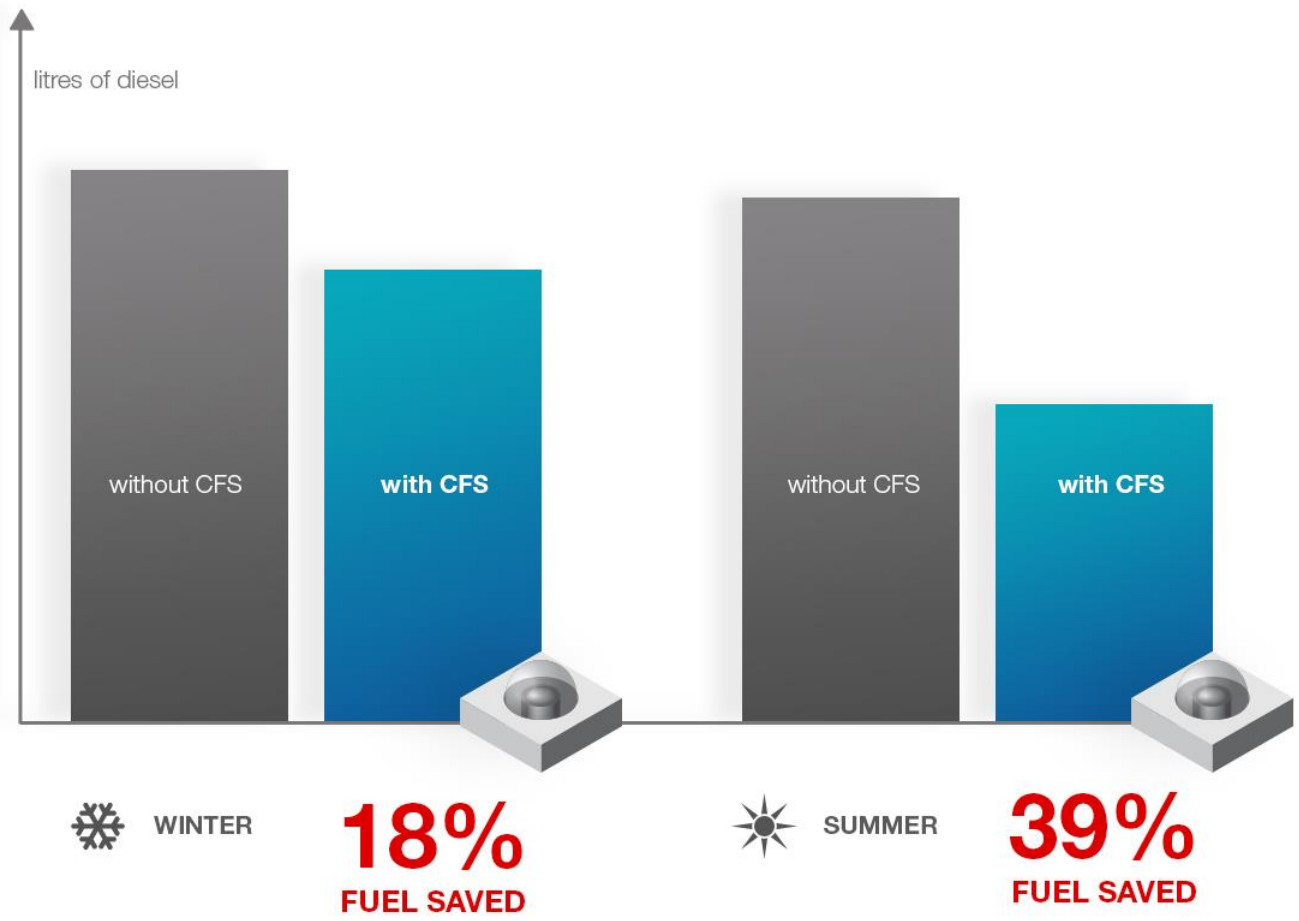
Reducing CO_2 emissions

Fuel consumption with and without **ComAp Cloud Forecasting System** (CFS)



Results of a case study from production facility with industrial load profile and 375 kVA diesel generator connected in parallel with a 1MWp PV plant. Location: California. Solar output data source: NREL

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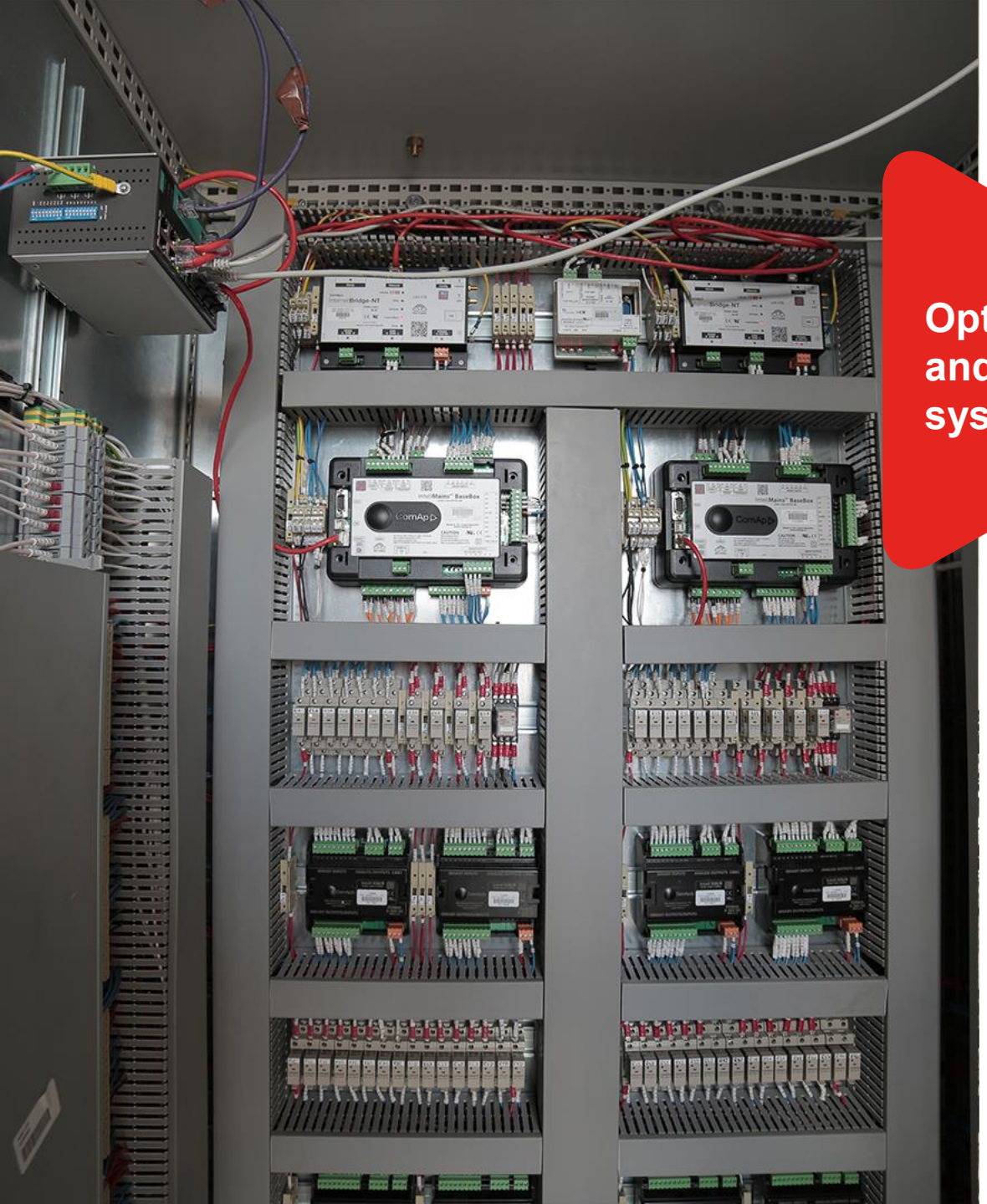
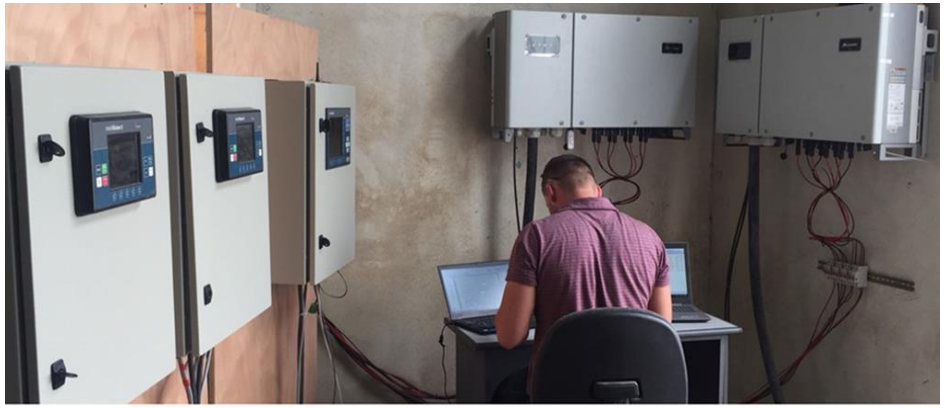
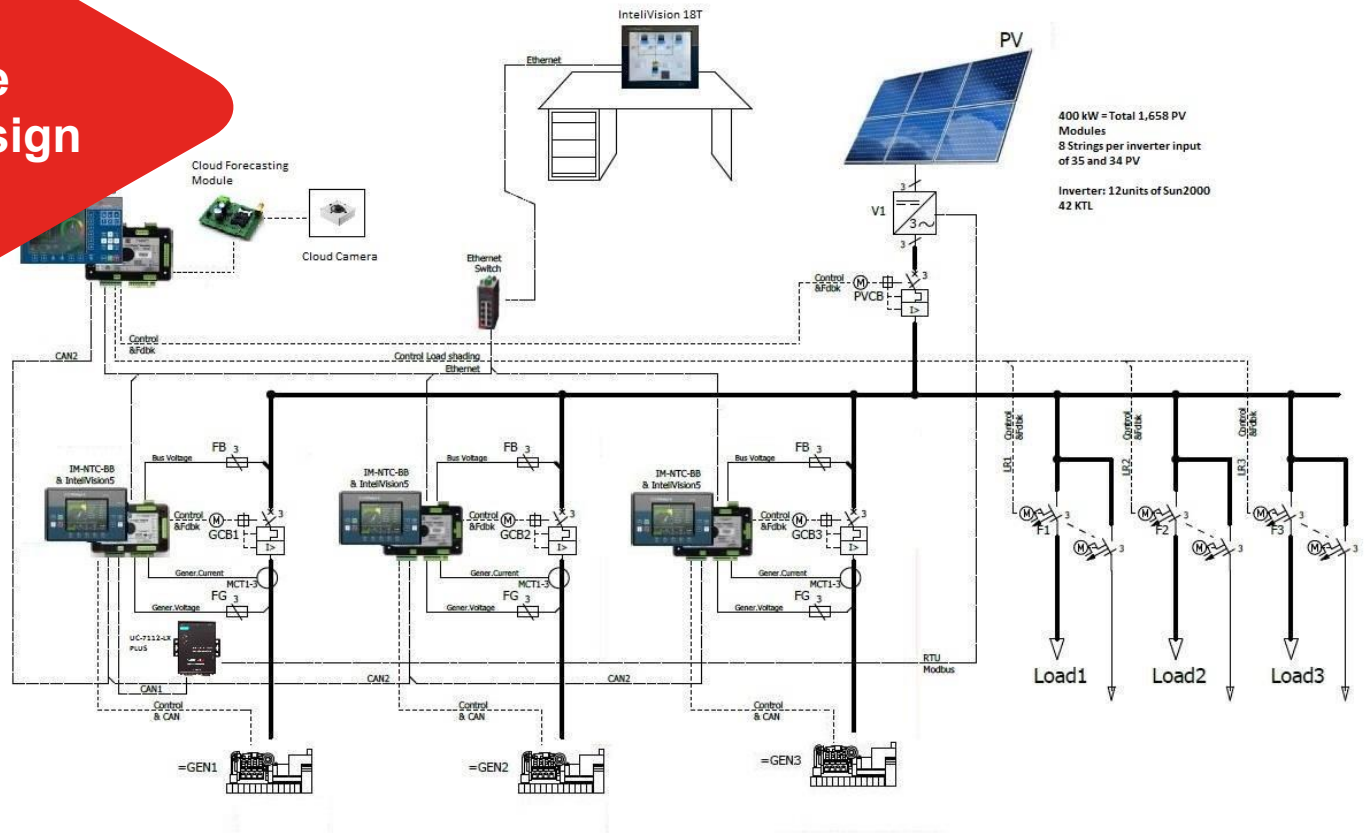
Lessons learnt



Optimized and tailored system



Site Design



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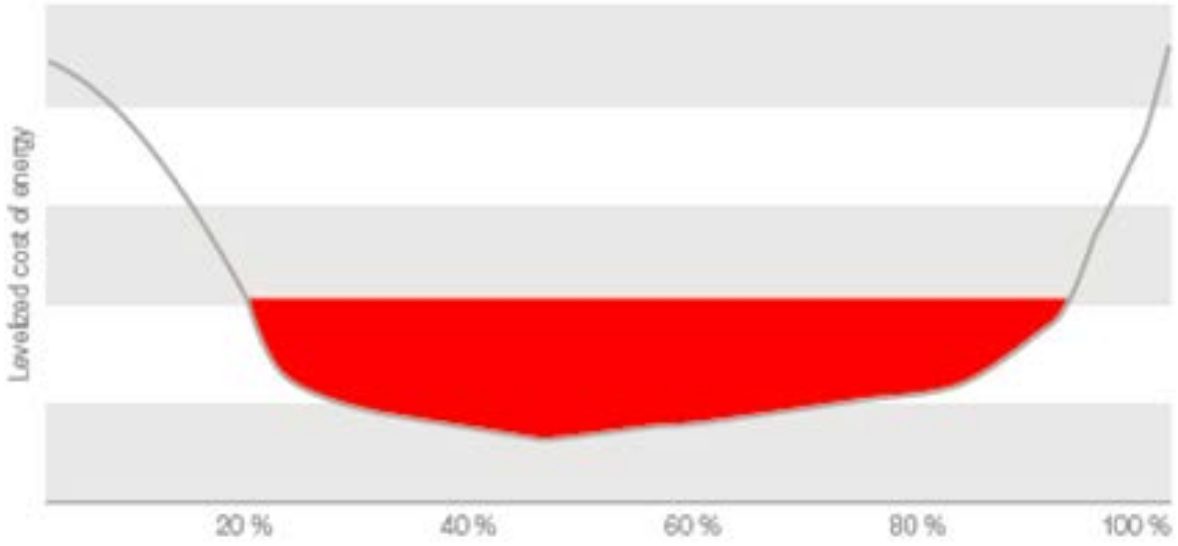
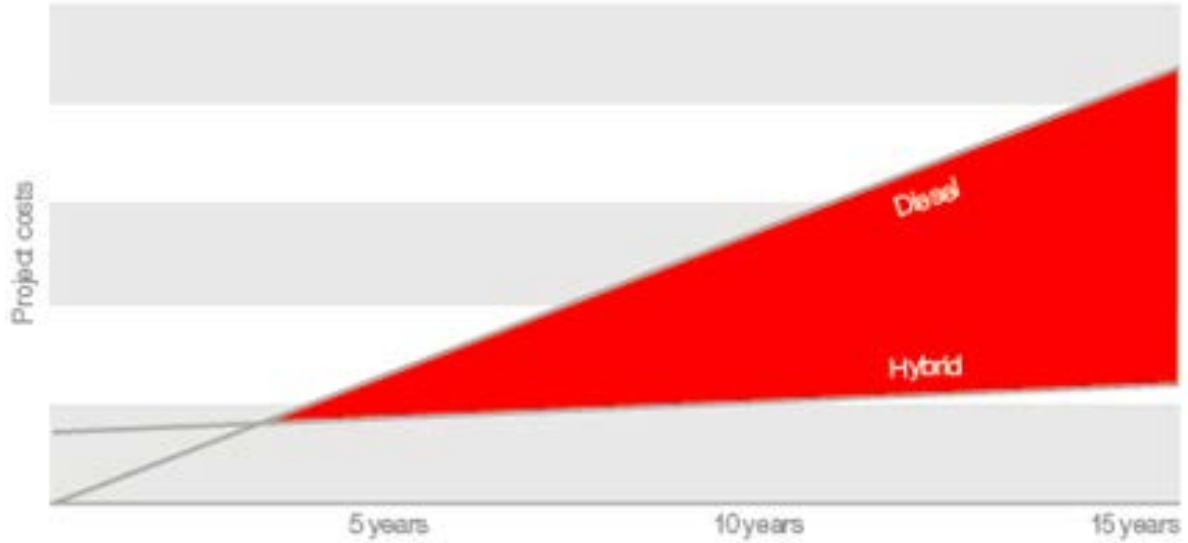
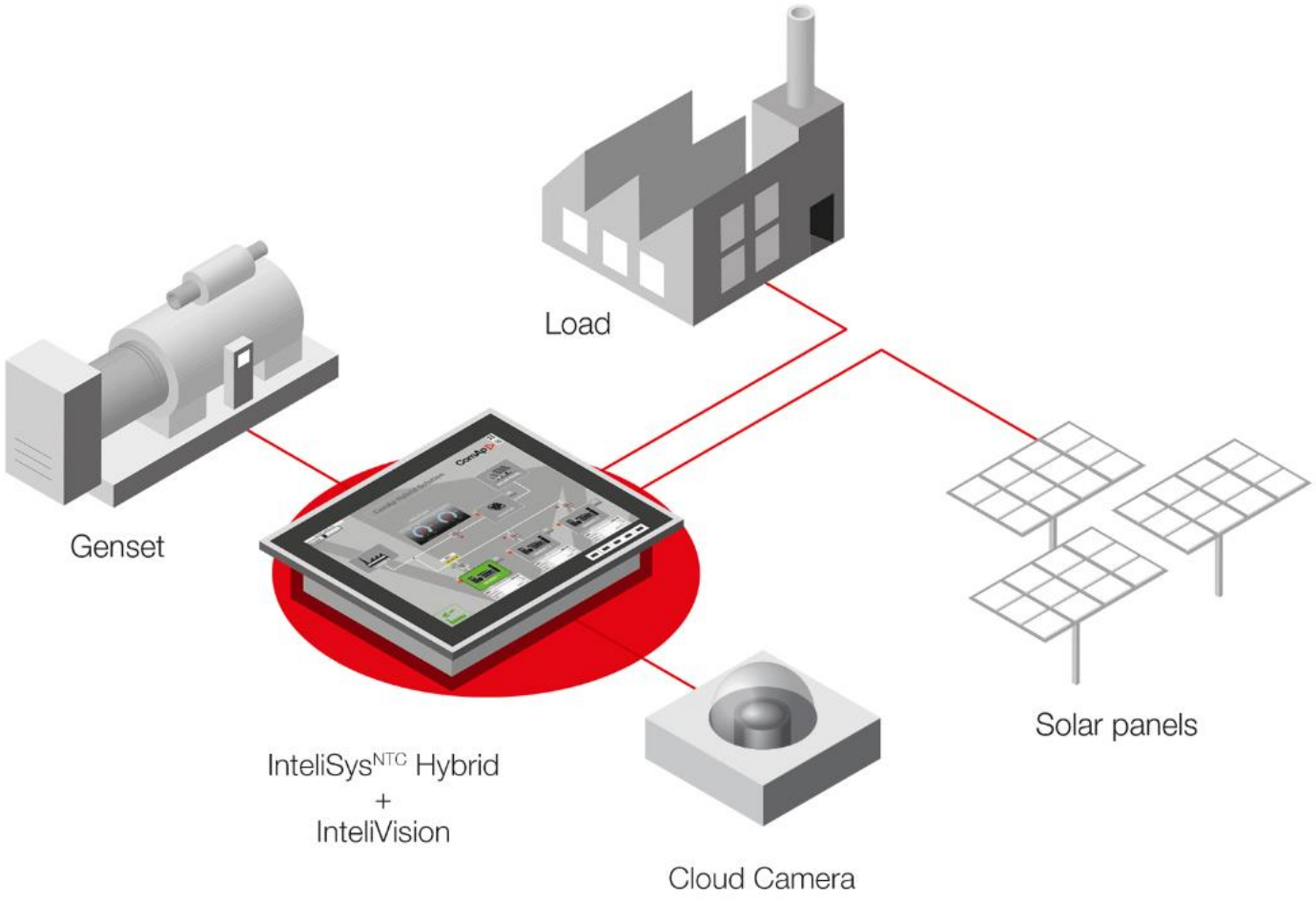
The economy of the system





- The highest system profitability is achieved within **40 – 60% of PV penetration**
- The typical break even point can be as short as **4 years**

Cloud forecasting system



Fuel consumption reduction

Efficient **power** outage risk elimination

Extended gen-set **life**

Operational **cost** optimization

Emissions reduction

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Conclusion

- **Hybrid microgrids are the future power systems**
  - Can run in island mode not to weaken the grid while maintaining power supply to consumers
  - Can support the grid (when aplicable)

- **Microgrids are sustainable, and technically and economically feasible**
- **Hybrid applications are the perfect match between reliability and efficiency**
- **Hybrid site desing is paramount for optimized OPEX, CAPEX, ROI and payback period**
- **Many problems with hybrid systems can be overcome with smart control systems**
- **High levels of penetration can be achieved even without large energy storage**
- **Lack of clear regulatory policy causes uncertainity, but is not a stumbling-block**

Why smart control is the key

- **Full automation of the diesel system**
- **Fast start-up configuration**
- **Overload capacity utilization**
- **Individual features consideration (slow vs.high speed gen-sets)**
- **Demand side management**
- **Dynamic spinning reserve adjustments based on:**
  - Penetration level
  - Characteristics of gen-sets
  - Historic load profile data (time of the day)
  - Known load changes
  - Predictions


ComAp
Save Fuel and Maximize Power System Reliability
That's smart control

Thank you for your attention

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